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2. ON THE INTENSIFICATION OF THE EMISSION OF THE NIGHT GLOW IN ZODIACAL LIGHT [Type Russian title]

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ON THE INTENSIFICATION OF THE EMISSION LINES OF THE NIGHT GLOW IN ZODIACAL LIGHT

by M. G. Karimov

In a spectrographic analysis of zodiacal light at the Mountain Observatory of the Astrophysical Institute in 1947, we showed for the first time [1] that the brightness of the lines of the nightglow is intensified in the region of the night sky into which the zodiacal light is projected.

This effect of intensification of the lines of the nightglow was also observed by G. A. Tikhov [2]. Later, however, Roach [3], while performing observations with an electric photometer, noted that it did not detect the presence of an intensification of the lines of the nightglow in zodiacal light, and that our results are within the limits of the measurement errors.

The article by Z. V. Karyagina in the present collection is devoted to the question of the accuracy of the measurements and to the detection of the intensification of the lines of the nightglow in zodiacal light. However, in our opinion, in addition to the comments on the work of Roach which have been made, one should note the inaccuracy in allowing for the background during the photoelectric measurements made by this author.

In measurements of the 5577 Å line, the portion of the continuous spectrum at 5300 Å was taken as the background. Thus, the calculation of the continuous background was made, not at the line or in the immediate vicinity of the line, but at a distance of almost 300 Å from the line.

This fact could undoubtedly affect the result of Roach's measurements and could account for the leveling of the intensification effect.

In the spring of 1956, we again organized observations to elucidate

the effect of the intensification of the lines of the nightglow at 5577 Å, and made use of a nebular spectrograph of Leontovskii's design, which cuts out 9° in the sky (Fig. 1). The spectrograph has a unique arrangement of the prisms (1). Two equilateral prisms have the same refracting angles within 2" and are parallel, acting as one large prism. Such an arrangement reduces the absorption loss.

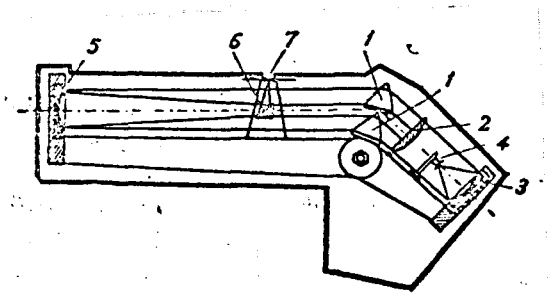

Fig. 1

The spectrograph has a Schmidt camera and a mirror collimator. A Schmidt lens (2) has a working diameter of 160 mm and a focus of 173.8 mm. The diameter of the mirror (3) of the Schmidt camera is 200 mm, the diameter of the mirror (5) of the collimator is 150 mm, the focus is 970 mm. The Schmidt camera has a speed of 1:1 and gives a dispersion of 335 Å per mm in the region of 5577 Å. The mirrors of the collimator and camera are aluminized. The entire optical system is enclosed in a plywood housing. The slit (7) of the spectrograph is disposed horizontally and is 50 mm long. The beam of light, after passing through the slit, strikes the diagonal mirror (6) and, after passing through the entire optical system of the spectrograph, collects at the film holder (4).

The slit of the spectrograph was fitted with a special attachment consisting of three prisms with total internal reflection which simultaneously projected on the horizontal slit of the spectrograph three portions of the sky of the same almucantarat with a 20° difference in the azimuth of each prism with respect to the neighboring prism. All the prisms were arranged

in the almucantarat of a zenithal distance of 75°.

At night, the central prism was aimed at the axis of zodiacal light. One of the end prisms with total internal reflection was aimed at a portion of the sky to the south of the axis of the zodiacal cone, the other was aimed to the north of this axis.

As we know, the zodiacal cone is asymmetrical, and more stretched out toward the northern portion of the sky. Therefore, using our attachment of three prisms with total internal reflection, we simultaneously obtained the spectra of zodiacal light and a spectrum from which zodiacal was completely or almost completely absent. We first obtained spectra of zodiacal light as long ago as 1947-1948, more recently, in the spring of 1956, on a panchromatic SChS film and Isopan Ultra, and later, on DK, RF-3 film. In the course of one night, the photographing lasted from 1 hr 30 min to 2 hr. The total exposure varied from 3 hr and 9 hr, depending on the type of film used. Thus, from two to four nights were spend on one picture. The spectrograph slit width was taken as 2 mm. The broadening of the slit was done in order to obtain, on the spectrum, a continuum of approximately the same density of tne emission line. The calibration was done with a standard spectrograph and a monochromator with approximately the same exposures as those used in photographing the zodiacal light. The light source employed was an illuminator whose light flux was attenuated the required number of times with neutral filters.

In March, 1956, we obtained spectrograms for four days of observations. All the pictures were measured with an MF-2 microphotometer.

The contours of the 5577 line were traced by the usual spectrophotometric methods.

In 1947-1948, the central brightnesses of the lines were taken from the

contours, allowing for the background of the continuum for the various parts of the night sky.

The intensity of the line to the south of the axis of zodiacal light was taken to be unity.

The values of the line intensity on the axis of zodiacal light were found to be greater than unity and amounted to 1.40 for the green 5577 line, according to the preliminary observational data. The method of processing the observations was somewhat different in 1956. Having the contours, we were able to calculate the total area of the 5577 line for the portion of the sky in zodiacal light and for the portion of the night sky 20° to the south of the zodiacal light.

As an example, Fig. 2 shows the contour of the green 5577 line for March 7, 1956. Intensities are plotted along the axis of abscissas in arbitrary units, and wavelengths are plotted along the axis of ordinates. The dotted curve corresponds to the zodiacal light, and the solid curve to the portion of the sky to the south of the zodiacal cone.

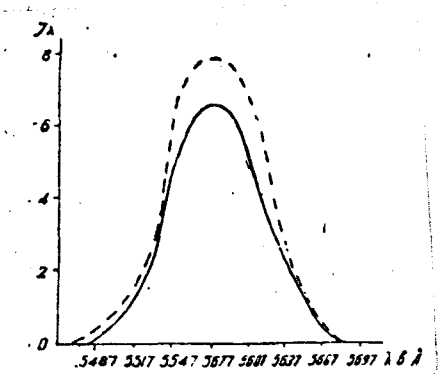

Fig. 2

The combined Table 1 shows the final data obtained from the four spectrograms of the 5577 Å line.

The second, third and fourth columns of this table give the intensities, allowance being made for the background of the continuum for the portions of the sky corresponding to the zodiacal light, to the south and north of the zodiacal light. The fifth, sixth and seventh columns give the

areas occupied by the contour of the line in the same arbitrary units of zodiacal light and portions of the night sky to the south and north of the zodiacal light.

Table 1

Date	I^{south}_{sky}	$I^{ill.}_{zod.}$	$I^{north}_{zod.}$	S^{south}_{sky}	$S^{ill.}_{zod.}$	$S^{north}_{zod.}$	$S^{north}_{zod} / S^{south}_{sky}$
7/III 1956	24,50	29,80	26,80	72,85	85,70	81,15	1,17
8/III 1956	32,70	40,60	35,60	56,10	65,00	60,60	1,16
9/III 1956	19,45	21,50	19,85	50,10	57,10	53,75	1,14
10/III 1956	30,55	32,30	30,20	41,50	47,80	45,10	1,15

In the course of the picture taking, the differences in the angular distances from the Sun were 36 to 60° in all cases. As can be seen from the last column of the Table, the intensification of the 5577 Å line of the nightglow if 15%, on the average.

Thus, it can be postulated that the lines of the nightglow are intensified in zodiacal light, but a greater number of observations must be made in order to explain their magnitude. In our view, this intensification effect is most probably variable.

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ABSTRACT

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On the basis of the new observational material is confirmed earlier obtained the effect of the enhancement of the brightness of the line of the night-glow in the Zodiacal light. The method of treatment of the spectrum was different, then in former times.

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